Residential Time-Based Pricing Trends

Consumer Preferences and Response to Pricing and Information

Chris King

President, eMeter Strategic Consulting

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Today's Presentation

Introduction

Program Highlights

- Puget Sound Energy Time-of-Use
- California Statewide Pricing Pilot
- Ameren Critical Peak Pricing
- Chicago Smart Pricing Plan
- Anaheim Public Utilities Spare the Power Days
- SmartPowerDC™

Generalizing the Results

Current Industry Status

eMeter Introduction

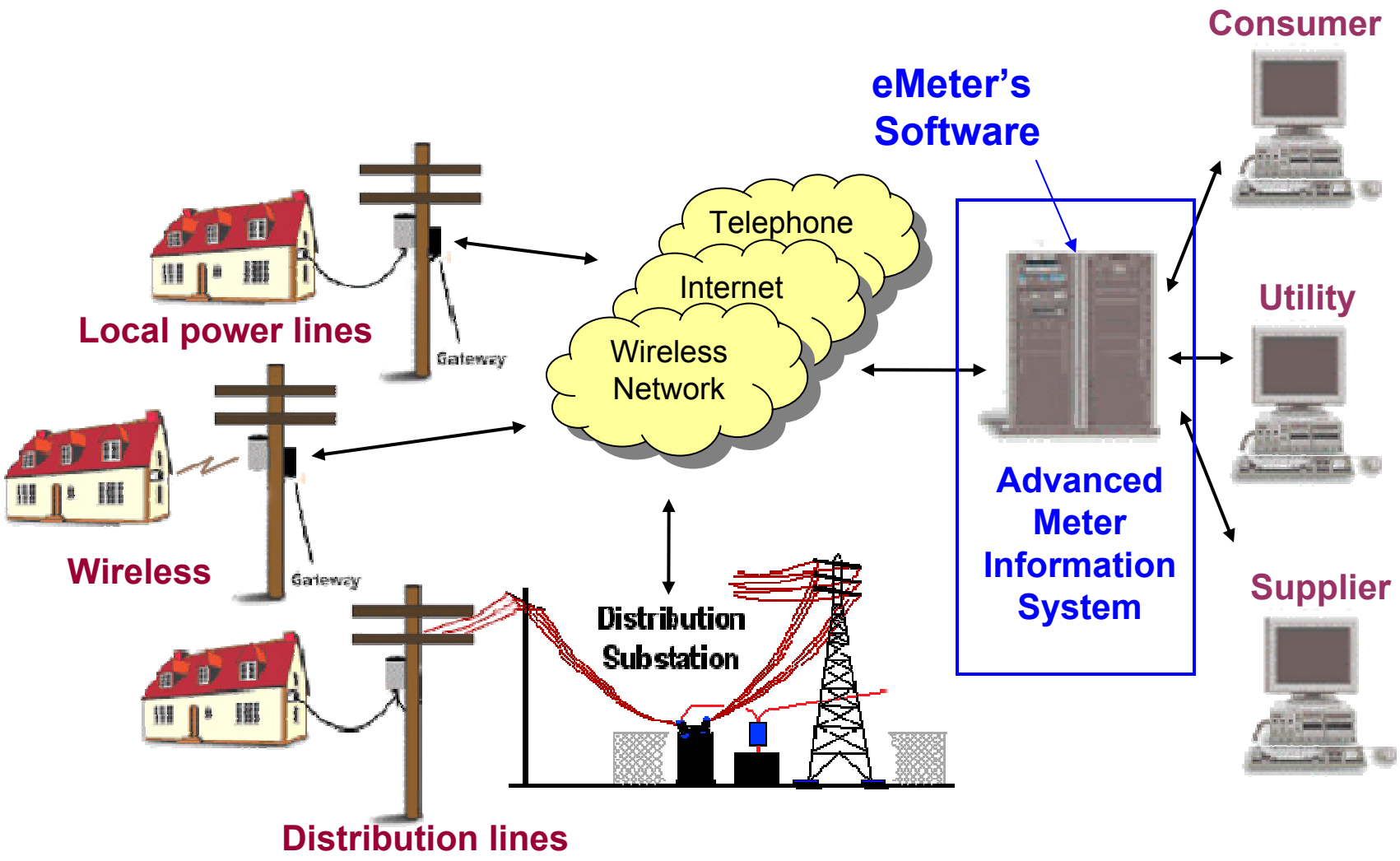
eMeter Corporation

- Principals active in smart metering and conservation since early 1980s
  - Developed, manufactured, deployed, and operated smart meters for over six million electric and gas customers in the U.S.
- Provides Meter Data Management (MDM) software to electric distribution companies
- Major clients include Pacific Gas & Electric (California), TXU Electric Delivery (Texas), CenterPoint Energy (Texas) and JEA (Florida)

eMeter Strategic Consulting

- Expertise in smart meter strategies and program planning
  - Pricing and consumer feedback
  - Smart meter and conservation technologies and marketing
  - Pilot experimental design
  - Business case and regulatory strategy
  - Standards
- Relevant projects include California Statewide Pricing Pilot, Spare the Power Days (Anaheim Public Utilities, California), and SmartPowerDC (Pepco, Washington, D.C.)

Advanced Metering: Where eMeter Fits



Introductory Comments

Technology

- Variety of advanced meters
  - Common denominator: hourly data
- Multiple communications methods
  - Meter communications via wireless, power line carrier, etc.
  - Price notification via automated telephone, pager, Internet, etc.
  - Program information via mail, email, Internet, etc.
  - Usage feedback via monthly bill, sometimes Internet

Markets

- Programs provided by the energy retailer
- Pricing inputs change over time
  - Wholesale prices
  - Time of peak
- Climate

Puget Sound Energy TOU Program

Smart meters deployed from 1997 through 2001

- Costs recovered from distribution operating company savings

Phase I: November 2000

- 400,000 customers
- Information provided on when they used energy

Phase II: May 2001

- 300,000 residential, 20,000 small commercial customers placed on time-of-use rates
  - 100,000 information only customers retained as controls
- Customers could opt out by calling or writing PSE
  - Less than 1 percent opted out

Phase III: June 2002

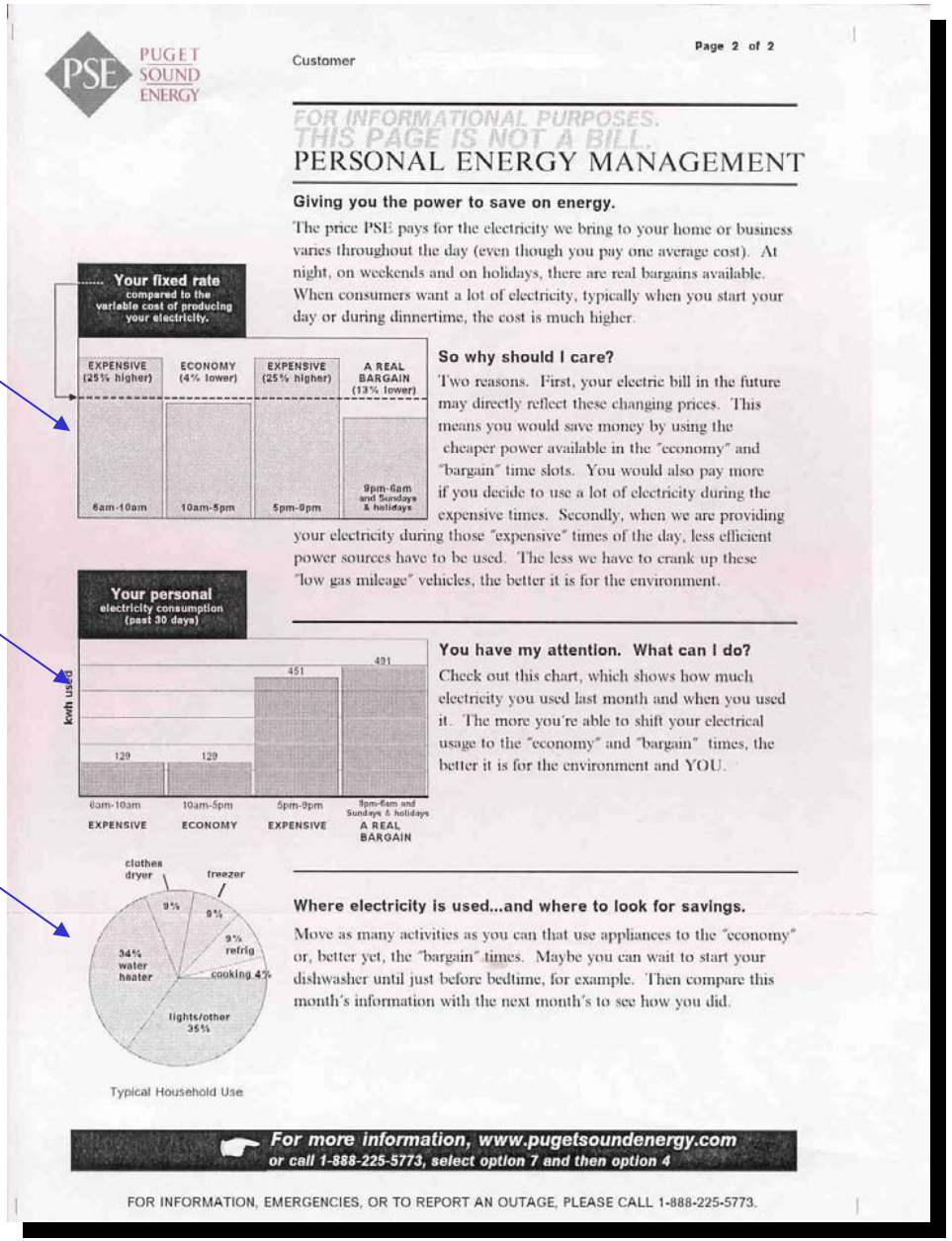
- Rate structure changed
- Negative press following mailing of bill comparison
- Opt out rate still only 1 percent
- By late 2002, PSE canceled the rate element of the program

PSE Monthly Bill Insert

Energy prices by time period

Energy usage by time period (actual)

How energy is used (sample)



PUGET SOUND ENERGY

Customer

Page 2 of 2

FOR INFORMATIONAL PURPOSES. THIS PAGE IS NOT A BILL.

PERSONAL ENERGY MANAGEMENT

Giving you the power to save on energy.

The price PSE pays for the electricity we bring to your home or business varies throughout the day (even though you pay one average cost). At night, on weekends and on holidays, there are real bargains available. When consumers want a lot of electricity, typically when you start your day or during dinnertime, the cost is much higher.

Your fixed rate compared to the variable cost of producing your electricity.

EXPENSIVE (25% higher) | ECONOMY (4% lower) | EXPENSIVE (25% higher) | A REAL BARGAIN (13% lower)

6am-10am | 10am-5pm | 5pm-9pm | 9pm-6am and Sundays & holidays

So why should I care?

Two reasons. First, your electric bill in the future may directly reflect these changing prices. This means you would save money by using the cheaper power available in the "economy" and "bargain" time slots. You would also pay more if you decide to use a lot of electricity during the expensive times. Secondly, when we are providing your electricity during those "expensive" times of the day, less efficient power sources have to be used. The less we have to crank up these "low gas mileage" vehicles, the better it is for the environment.

Your personal electricity consumption (past 30 days)

kwh used

129 | 129 | 451 | 491

6am-10am EXPENSIVE | 10am-5pm ECONOMY | 5pm-9pm EXPENSIVE | 9pm-6am and Sundays & holidays A REAL BARGAIN

You have my attention. What can I do?

Check out this chart, which shows how much electricity you used last month and when you used it. The more you're able to shift your electrical usage to the "economy" and "bargain" times, the better it is for the environment and YOU.

Typical Household Use

Where electricity is used...and where to look for savings.

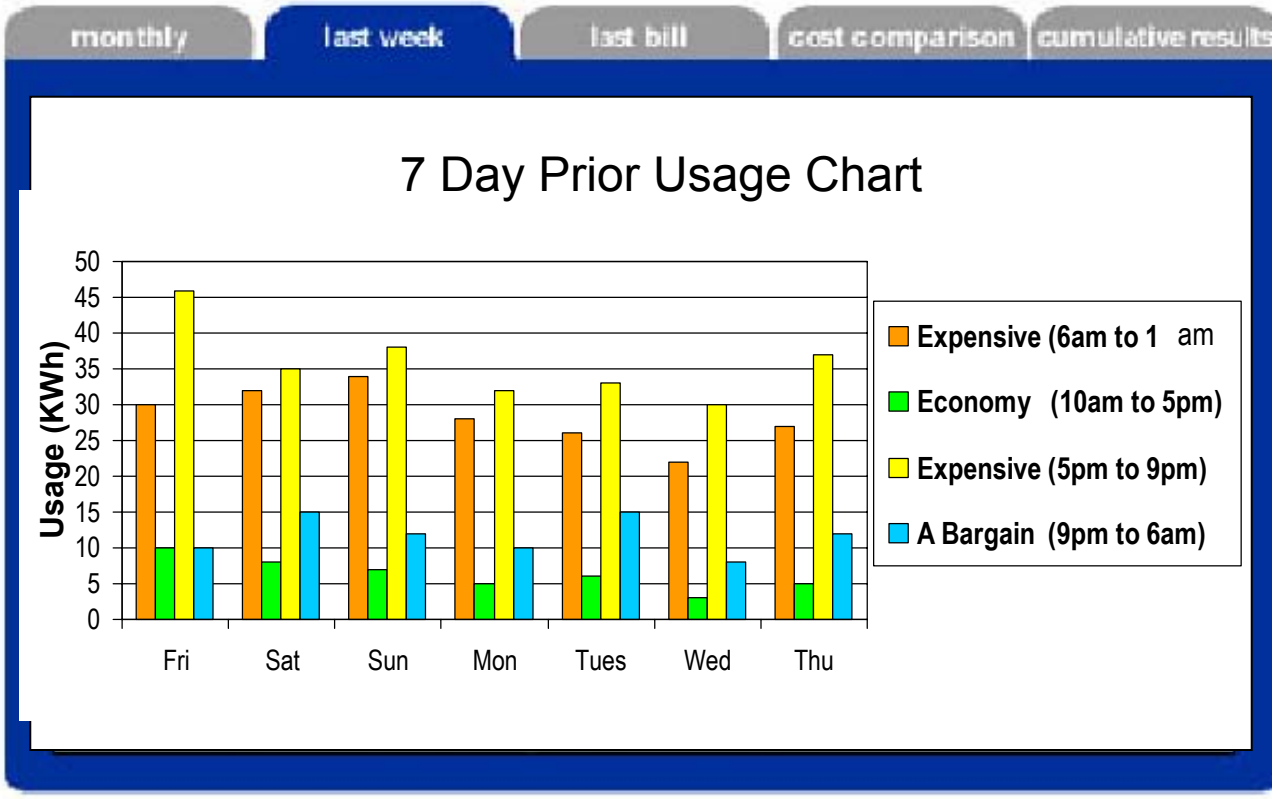
Move as many activities as you can that use appliances to the "economy" or, better yet, the "bargain" times. Maybe you can wait to start your dishwasher until just before bedtime, for example. Then compare this month's information with the next month's to see how you did.

For more information, www.pugetsoundenergy.com or call 1-888-225-5773, select option 7 and then option 4

FOR INFORMATION, EMERGENCIES, OR TO REPORT AN OUTAGE, PLEASE CALL 1-888-225-5773.

Customer usage before

Customers on the pilot get personal online reports of energy use



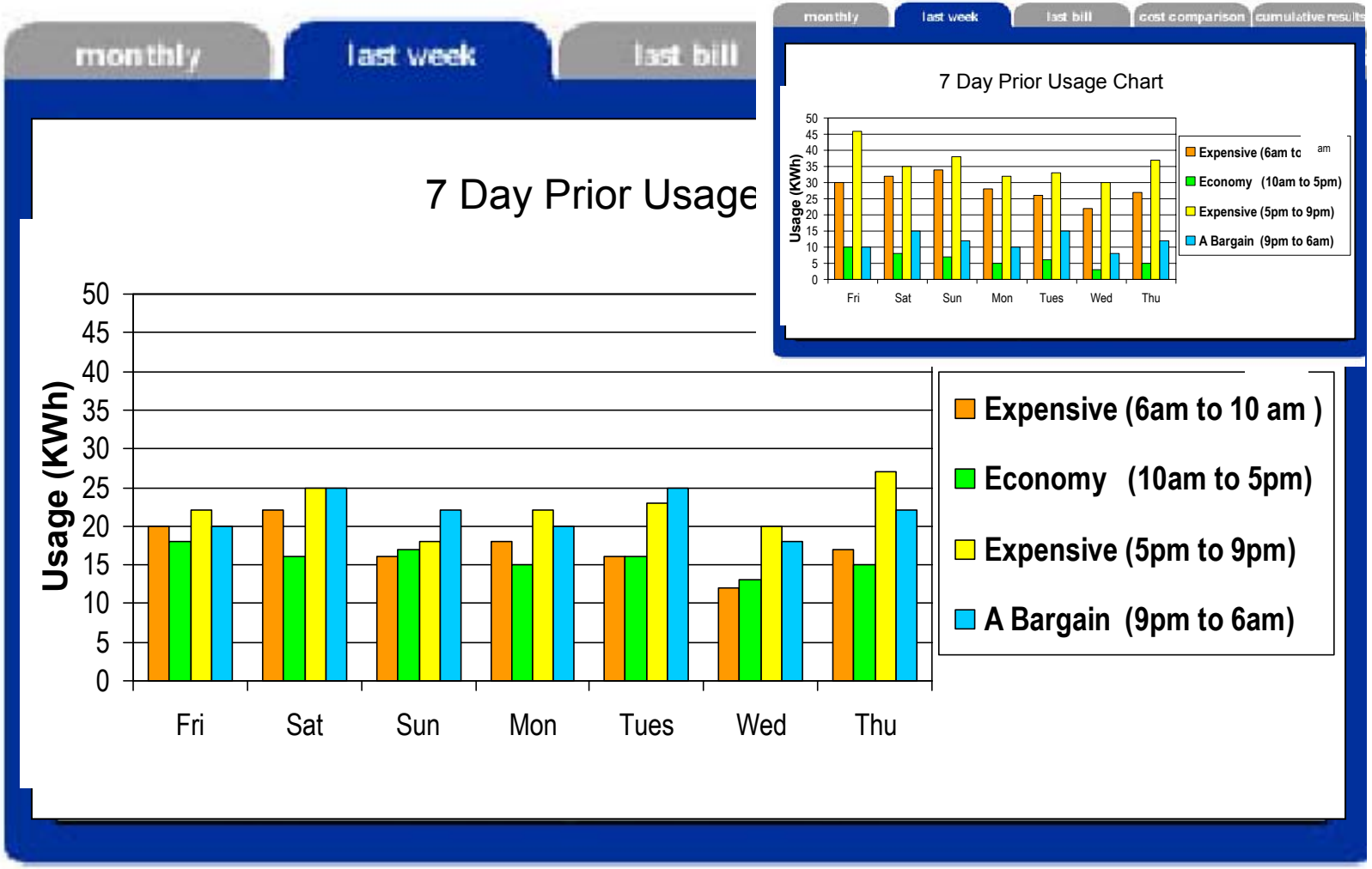
But, after a few weeks...

Note that this customer's use is primarily in expensive time periods:

PSE Website

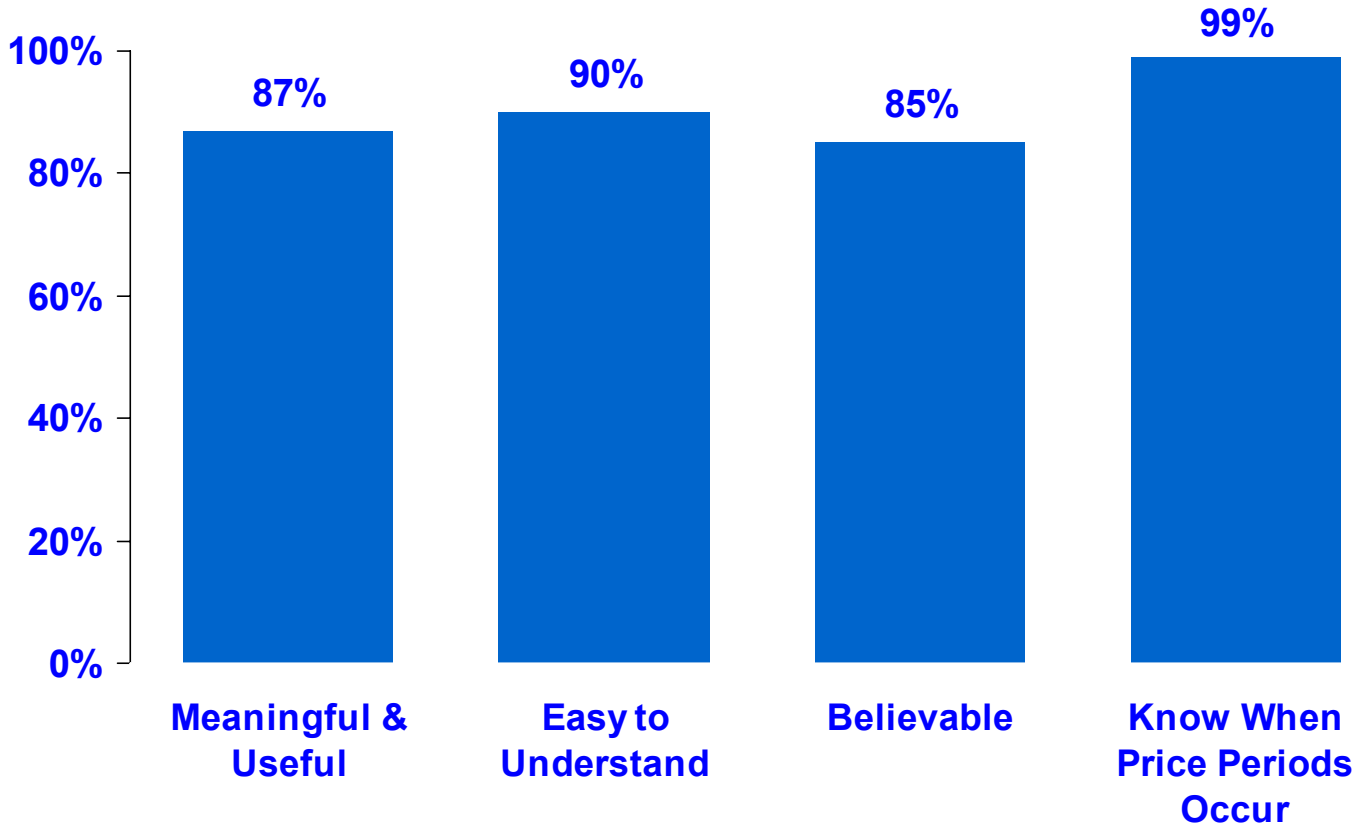
Customer usage after

Previous usage by comparison…



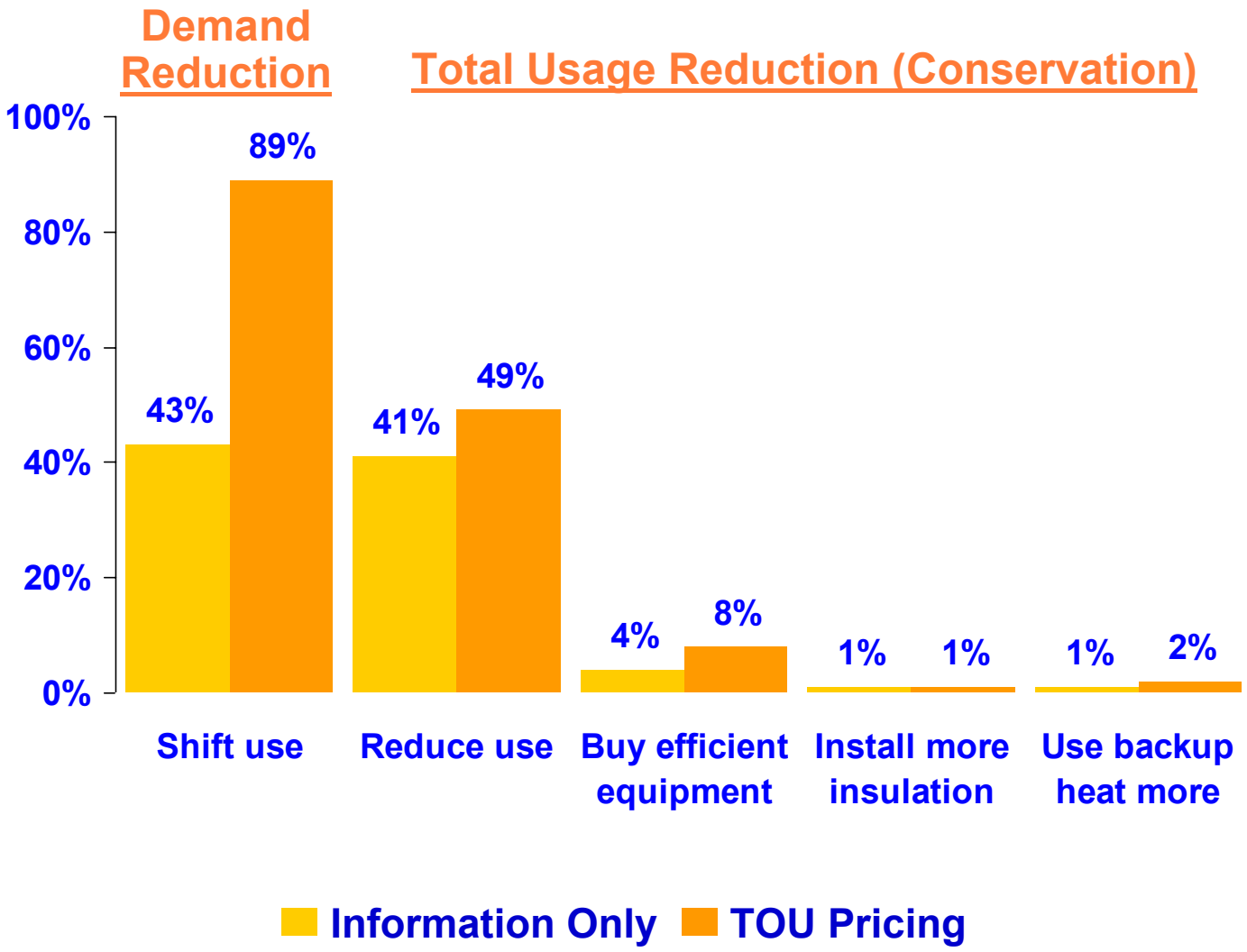
Strategic Consulting

PSE Customer Reaction to Information

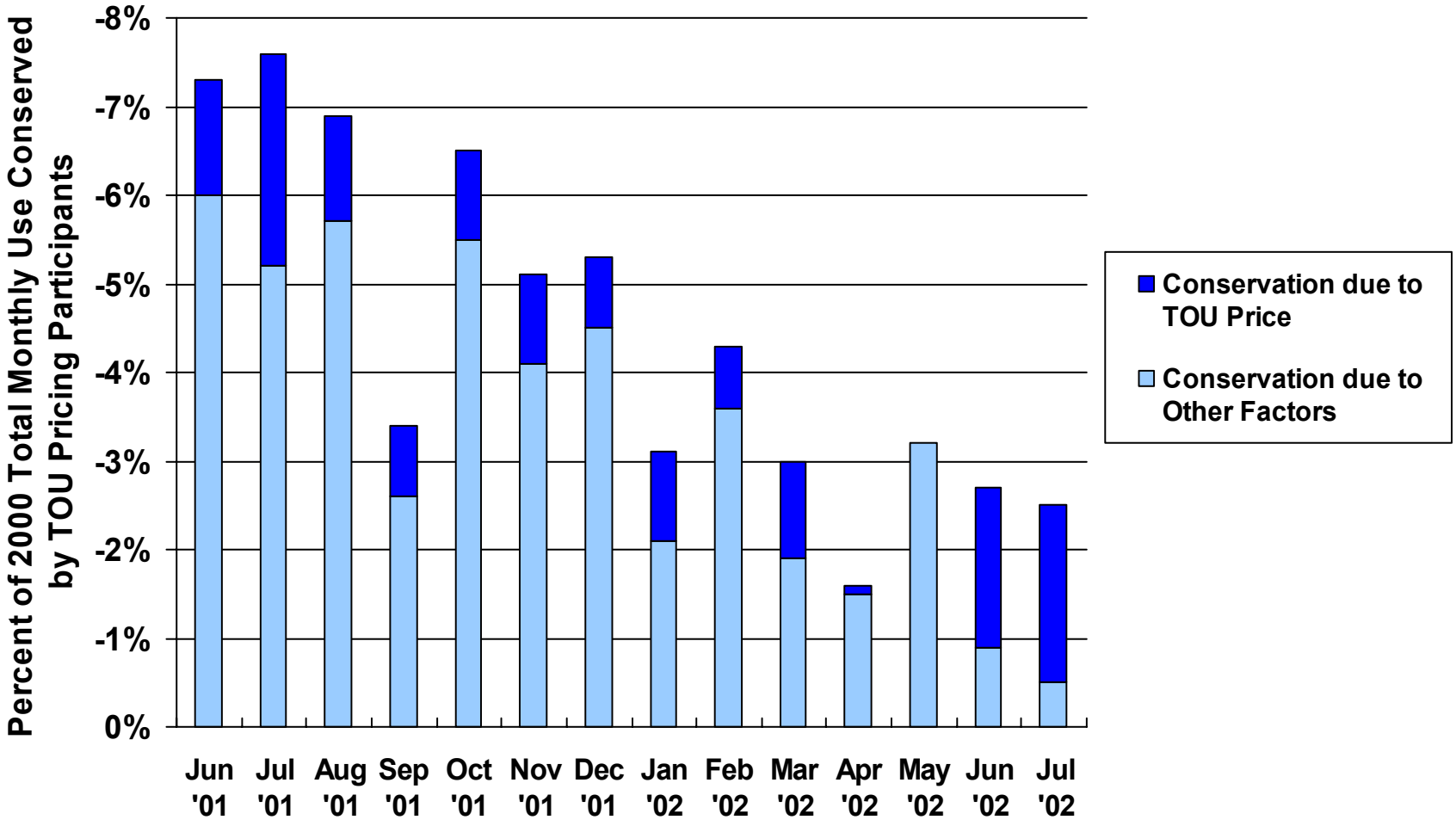


Types of Actions Taken by PSE Customers

Self reported in response to feedback or pricing



PSE Conservation Effect



Graph represents difference between post-program energy use and weather-adjusted 2000 monthly (pre-program) use.

Context: Conservation Effect

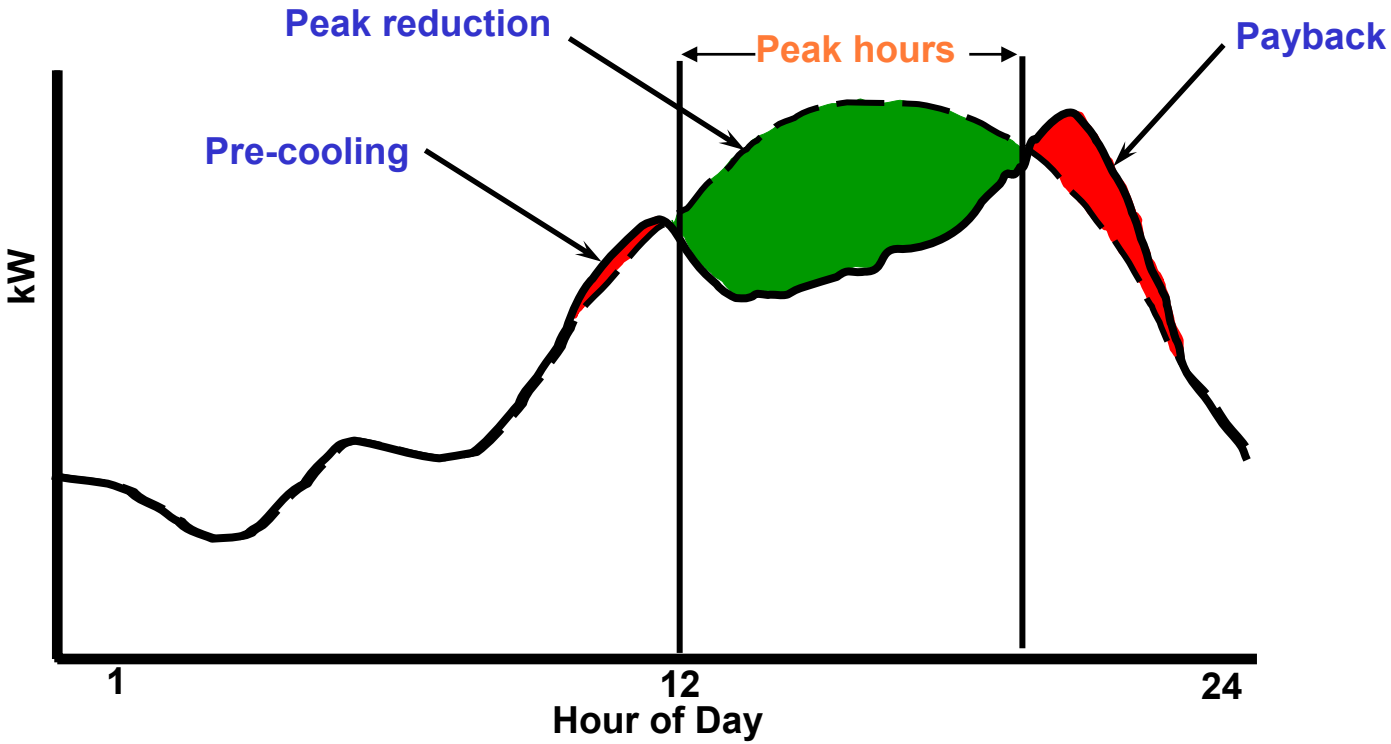
Payback or pre-cooling/heating occurs for some end uses

- Air conditioning, electric heating, electric water heating

No payback for other end uses

- Turning off lights
- Using microwave instead of oven

Literature survey found conservation averaging 4%



PSE Consumer Market Research Results

Satisfaction

- 91% - “I would recommend it to a friend.”
- 85% - “I would remain on the program.”

Attitudes

- 66% - “TOU reduces the need for power plants.”
- 64% - “TOU pricing is fair.”
- 37% - “Consumers should pay the same price no matter what time of day they use power.”

Understanding

- 72% - “The TOU concept is easy to understand.”

California Pricing Pilot

Summary

- Pacific Gas & Electric, San Diego Gas & Electric, and Southern California Edison
  - Together representing 11 million electric customers
- Sample of 2,500 customers statistically representative of the entire state
- Residential and small commercial (<200 kW) customers
- July 2003 through December 2005

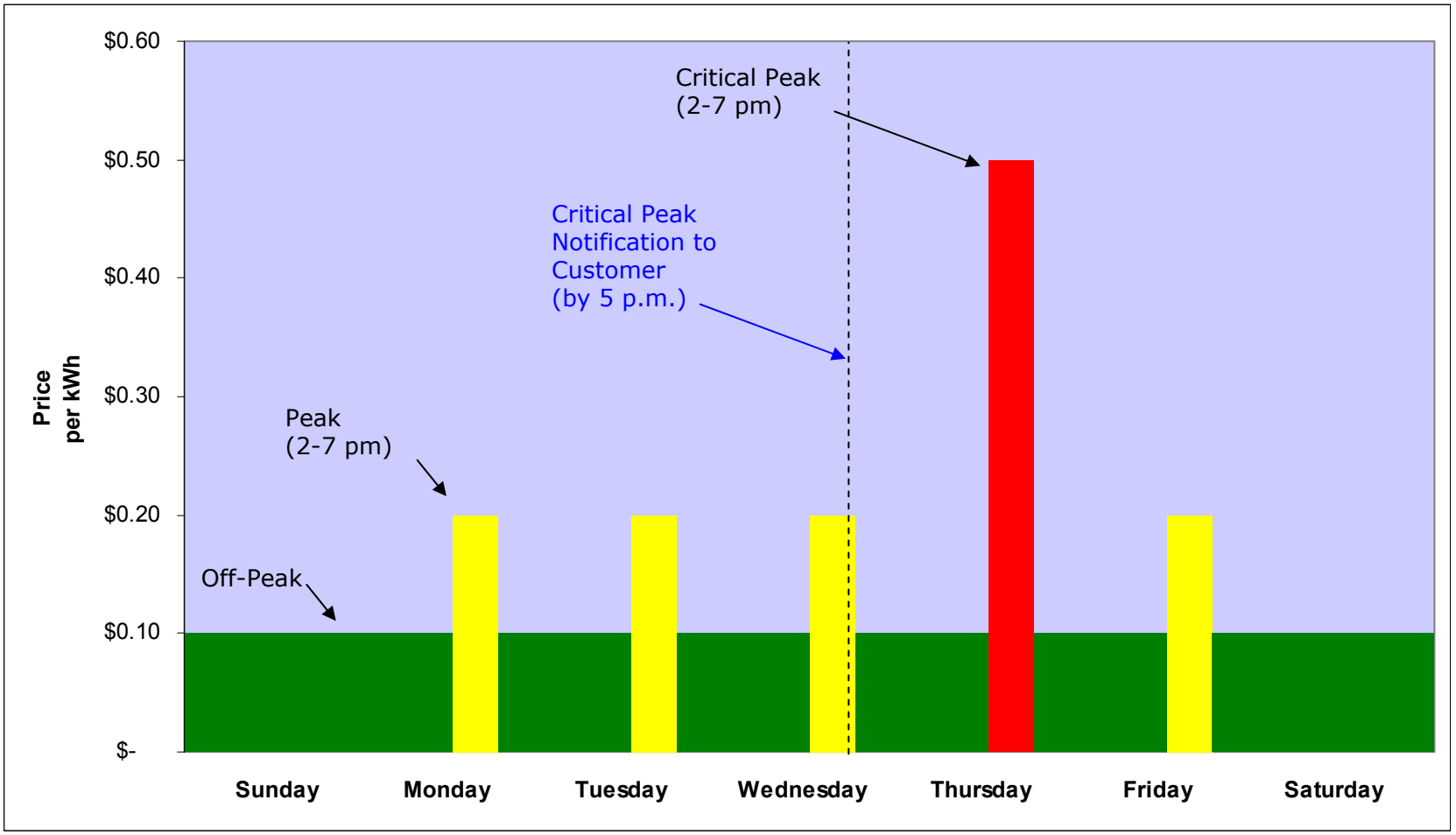
Goals

- Measure peak demand reductions
- Measure conservation effect
- Assess customer preferences via participant experiences and market surveys

Experimental treatments

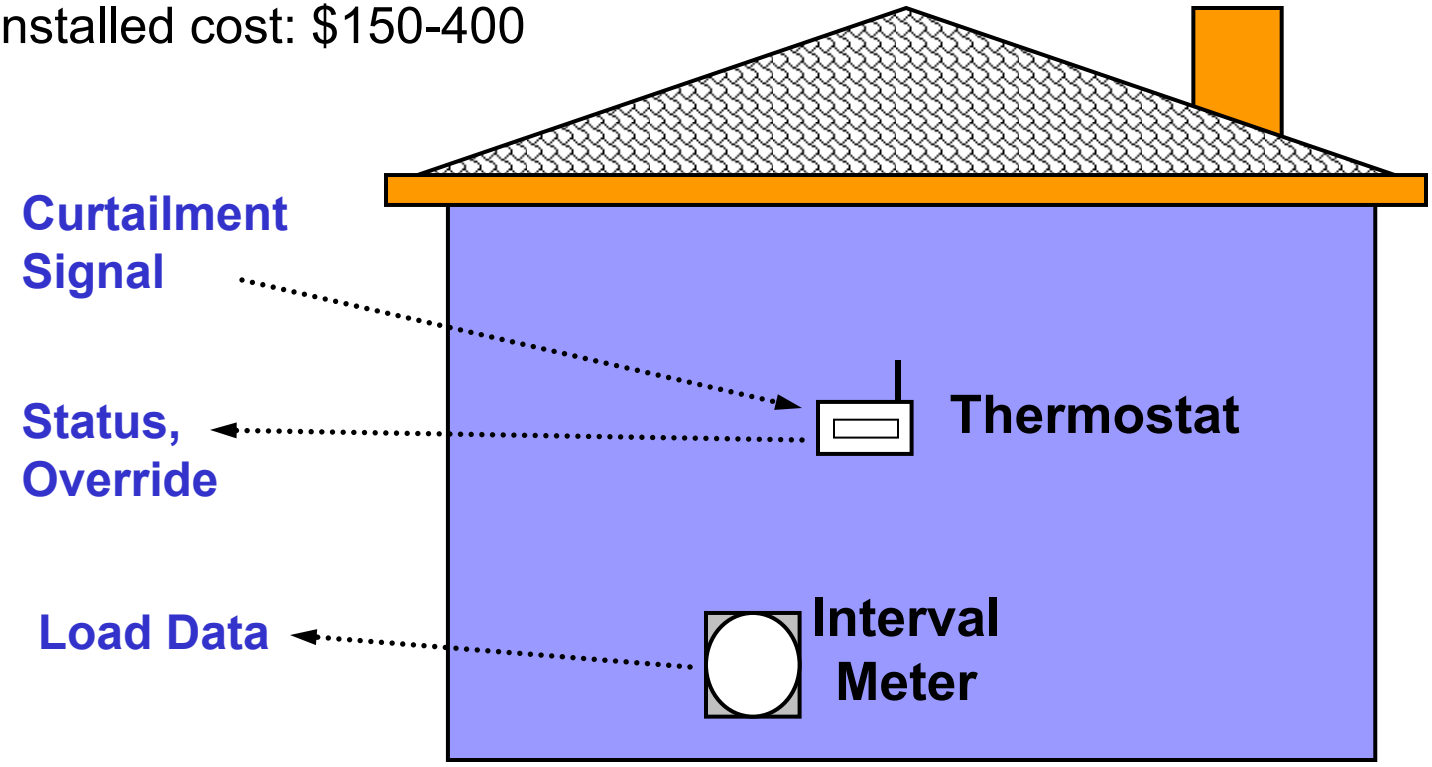
- Pricing (TOU and Critical Peak Pricing)
- Control technology (none, smart thermostat, smart home)
- Information (information only, standard, “rich”)

Critical Peak Pricing Structure



Smart Thermostat Control

- Thermostat has built-in paging radio (doesn't go through meter)
  - Remote, Web-based programming and operation
- Automatically adjusted up 4 degrees during critical peaks
  - Local override option
- Installed cost: $150-400



Source: Karen Herter, California Energy Commission

Monthly Bill Summary

Energy prices by time period

Visual reminder of prices by time period

Account Number

ABC-12344567

Super Peak Events – Last Billing Period

June 14, 2003
2 p.m. to 7 p.m.

June 15, 2003
2 p.m. to 7 p.m.

June 29, 2003
2 p.m. to 7 p.m.

Pricing Periods

Super Peak Hours
From 2 p.m. to 7 p.m. during critical system conditions. Customers are notified by 5 p.m. the day prior to the event.

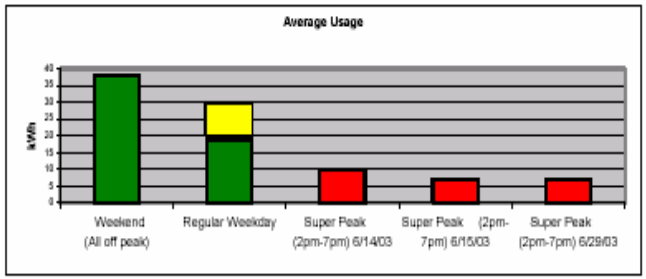
Peak Hours
From 2 p.m. to 7 p.m. weekdays except holidays

Off-Peak Hours
Weekdays from midnight to 2 p.m. and 7 p.m. to midnight
All day on weekends
All day on holidays

ELECTRICITY BILL SUMMARY

THIS IS NOT A BILL. SEE YOUR BILLING STATEMENT.

Usage	Service Dates	Amount
Super Peak Electricity	06/03/2003 To 07/02/2003	24 kWh
On-Peak Electricity	06/03/2003 To 07/02/2003	182 kWh
Off-Peak Electricity	06/03/2003 To 07/02/2003	721 kWh
Total Electricity Use		**927 kWh**

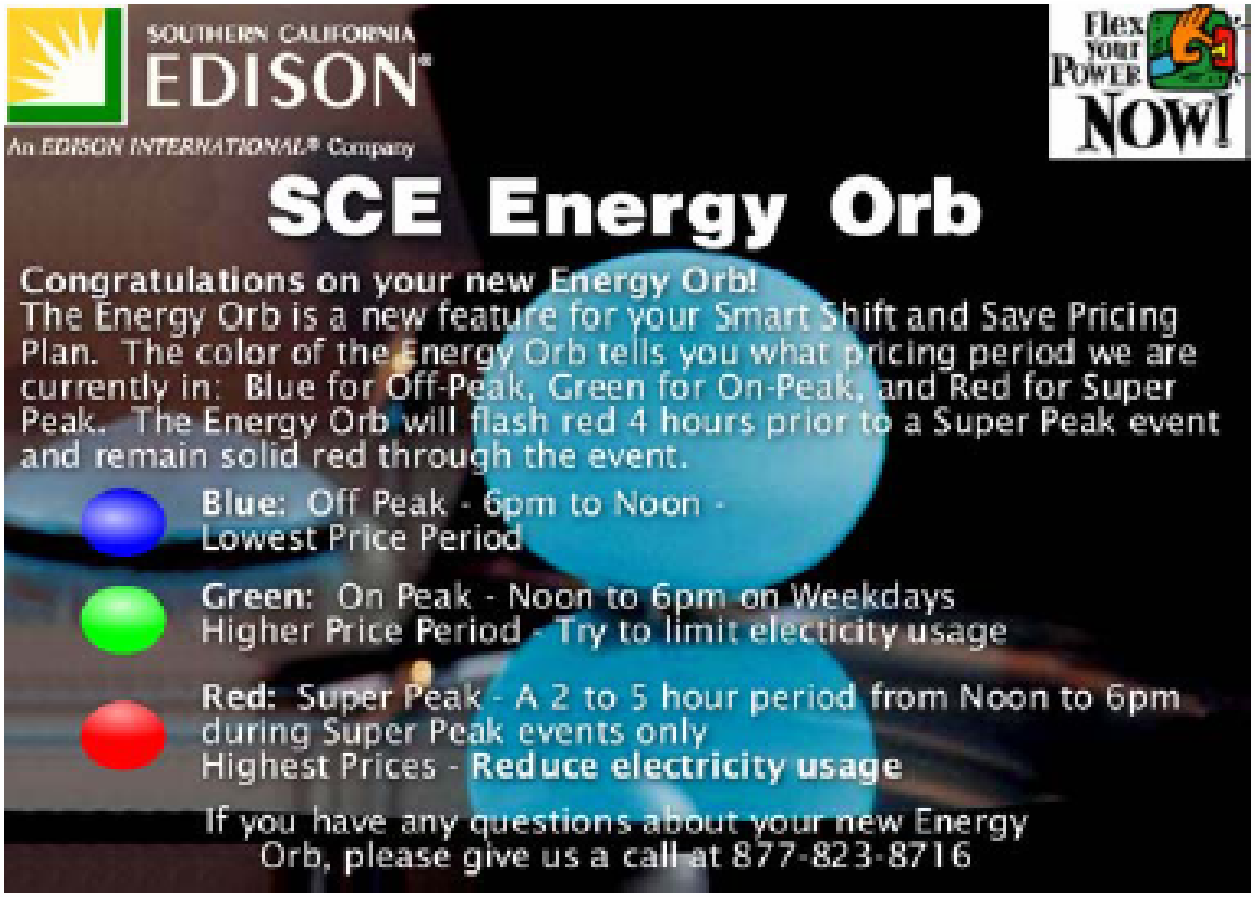


Charges	Total Bill Amount	Effective Price*
Super Peak Electricity	$12.00	$0.50 per kWh
On-Peak Electricity	$58.24	$0.32 per kWh
Off-Peak Electricity	$70.85	$0.10 per kWh
Total Charges	**$141.09**	

Energy Orb

Radio-equipped, frosted glass bulb

Energy prices signaled by orb color



Enhanced Information Treatment

Information and analyses available on website and via printed and emailed reports

- Examples: home summary report, behavior vs. savings analysis

Figure 4: Home Energy Center

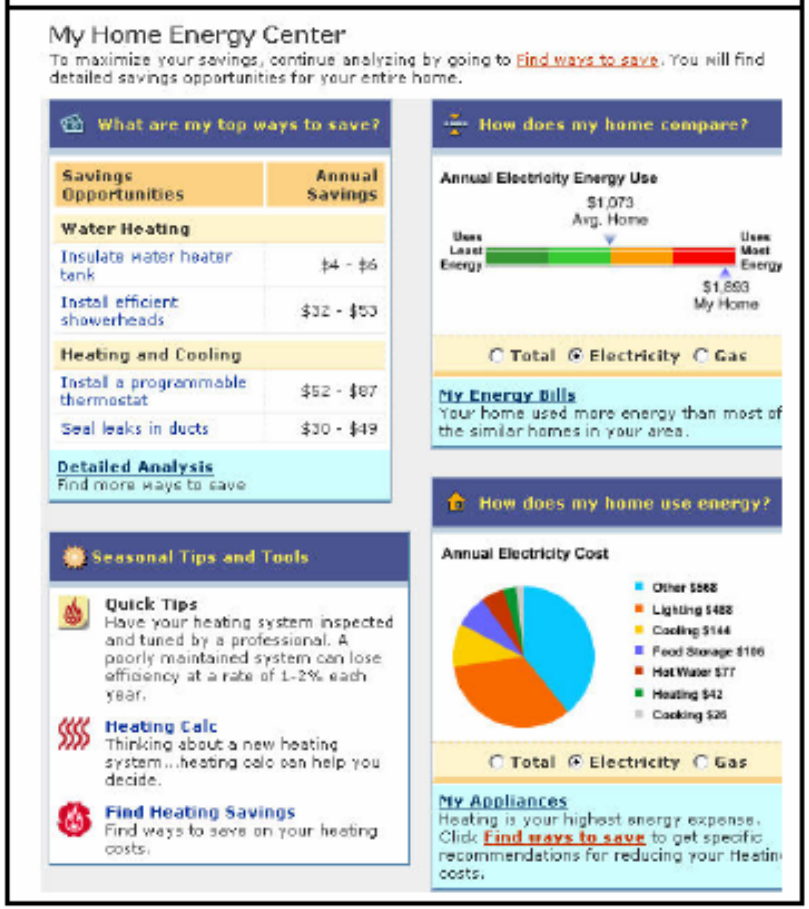


Figure 7: Load Shift Calculator

Statewide Pricing Pilot Results - Residential

Rates went into effect July 1, 2003

12 events called during each summer, 2003 and 2004

Performance Measure	Average from the Literature	California SPP Result
Price elasticity	-0.30	-0.15
Peak demand reduction – CPP without automated response	24%	13%
Peak demand reduction – CPP with automated response	44%	35%

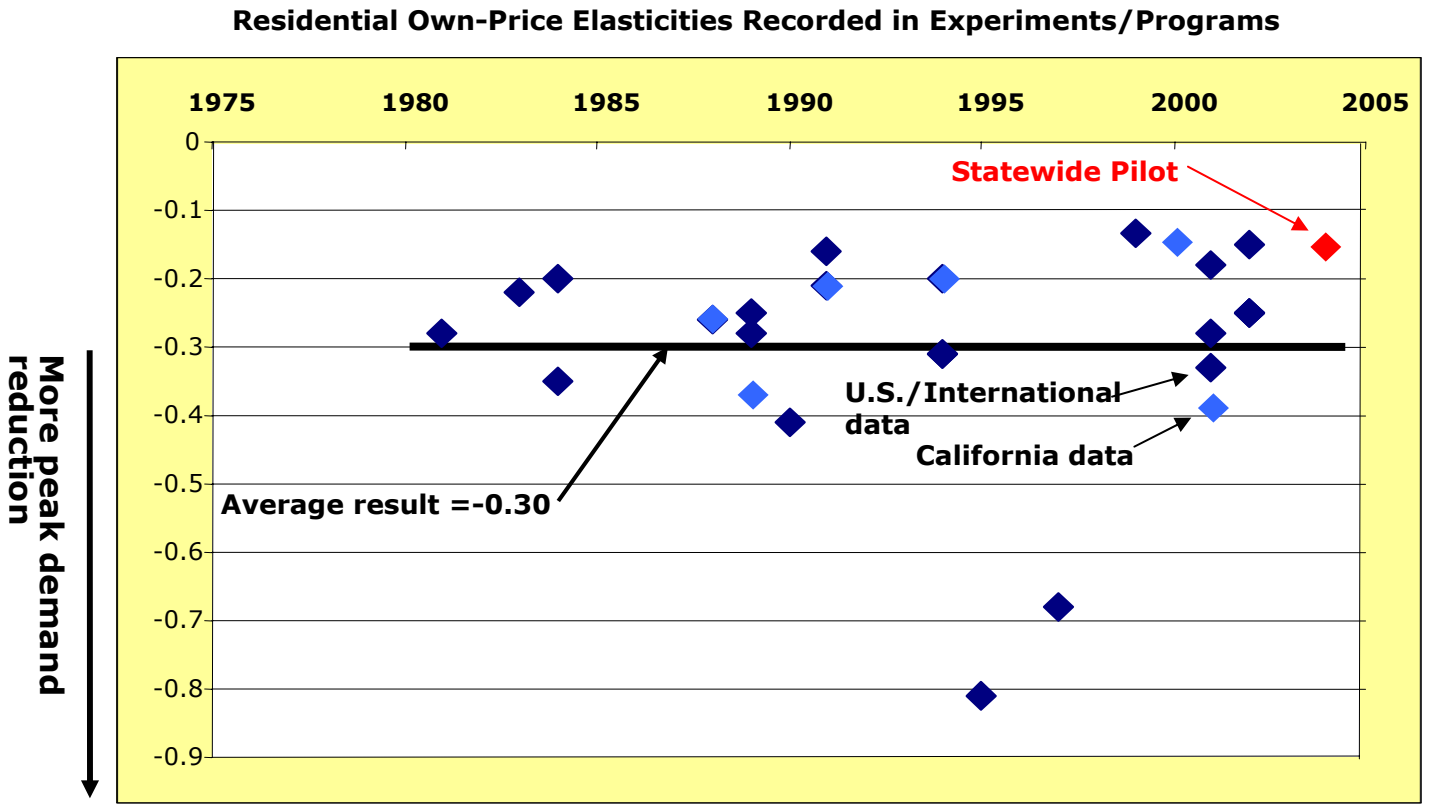
Context: Residential Price Response

A common measure is price elasticity

- The amount of usage reduction in response to a price increase

Fifty-six analyses and projects in the past 25 years

California's pilot provided one more data point

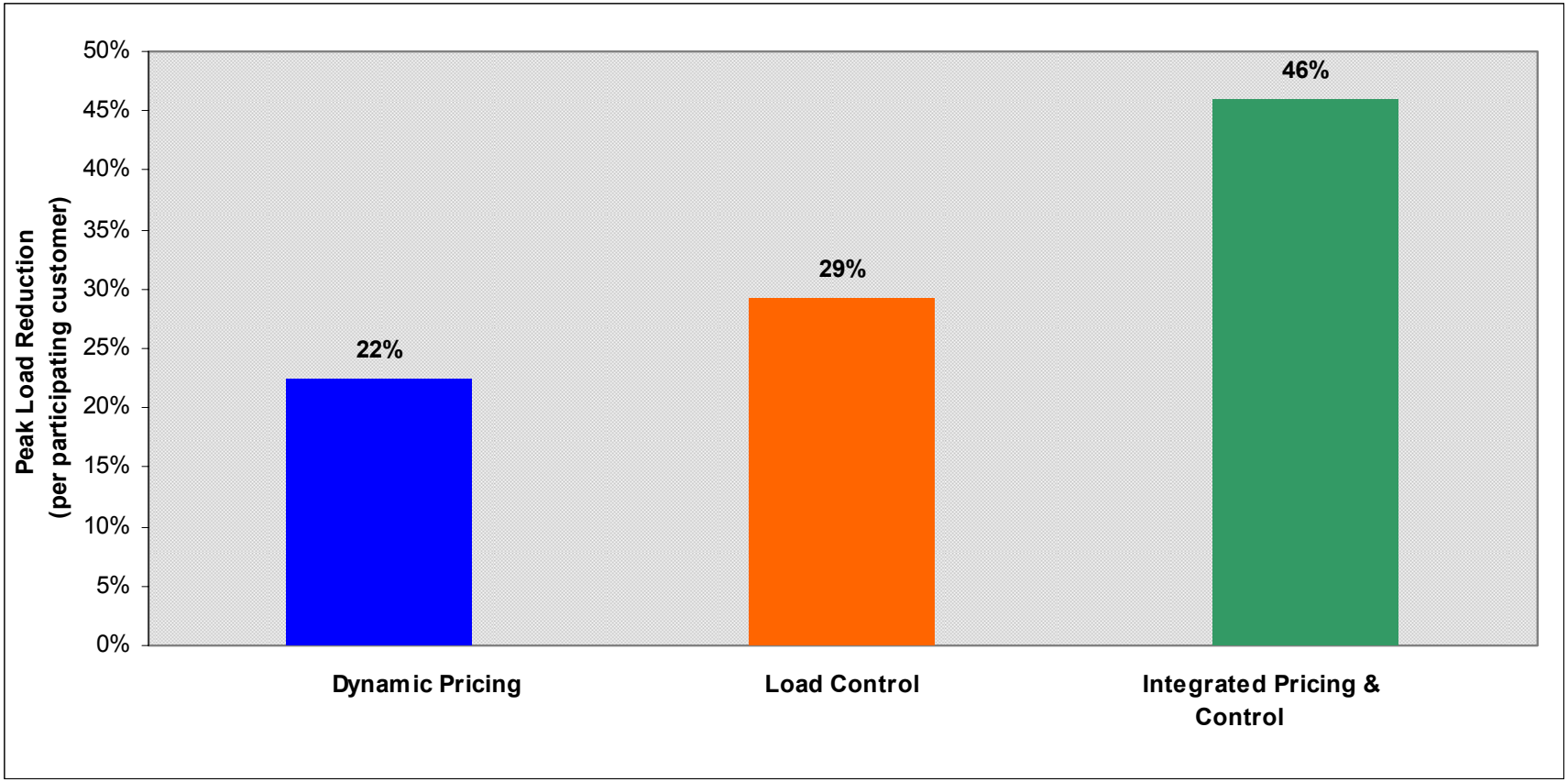


Source: King and Chatterjee, *Public Utilities Fortnightly*, July 1, 2003

Context: Combining Control and Pricing

Literature survey

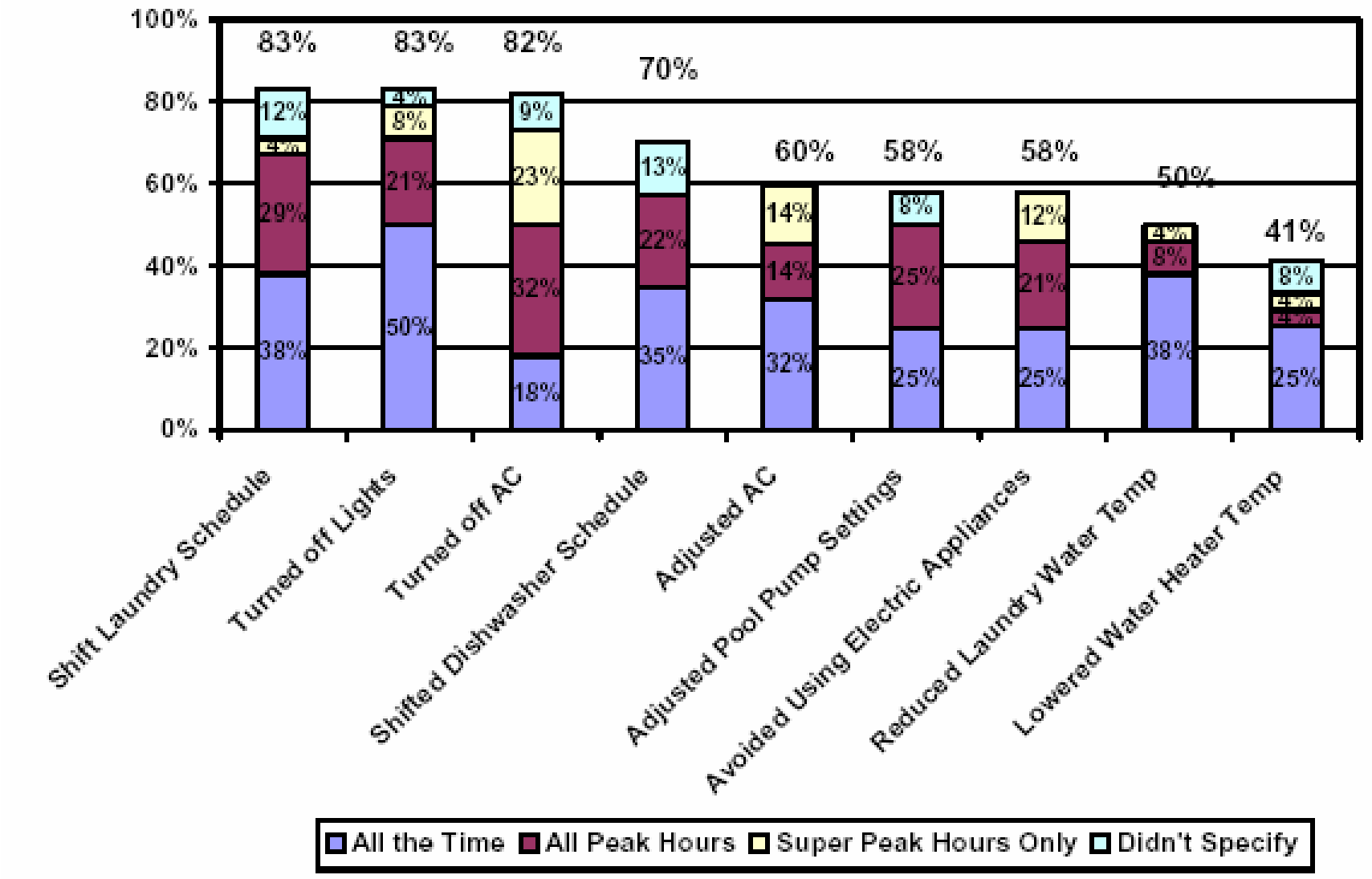
- Key finding: automatic control and pricing are synergistic



Source: King, "Advanced Metering and Load Control: The Literature," *EnergyPulse*, December 2004

California Results: Consumer Behavior

Percent of customers self-reporting taking each action and when



Source: Nexus Energy Software, Final Report: Information Display Pilot, California Statewide Pricing Pilot, January 5, 2005.

Ameren CPP Pilot Overview

AmerenUE

- Residential Time-Of-Use ("RTOU") Pilot study
- Spring of 2004

Three participant groups:

- Three tier time-of-use rate with high differentials
- Three tier time-of-use rate with high differentials subject to a critical peak pricing ("CPP") element
- Three tier time-of-use rate with high differentials subject to a critical peak pricing ("CPP") element and enabling technology, a "smart thermostat", that automatically increased customers thermostat settings during critical peak pricing events

Ameren Project Objectives

Purpose

- Obtain information needed to determine if and how residential time-of-use rates will be beneficial in Missouri.

Report Goals and Analysis:

- Evaluating the pros/cons and cost effectiveness of TOU program designs
- Estimate the demand reduction occurring at the AmerenUE system peak;
- Determine the magnitude of the load shifted between on-peak and off-peak periods;
- Estimate the impact, if any, of the energy conservation as a result of this pilot
- Estimate the load reduced during the critical peak pricing periods;
- Determine the amount of load “payback” that occurs immediately following the critical peak pricing periods

.

Cannon/Honeywell ExpressStat

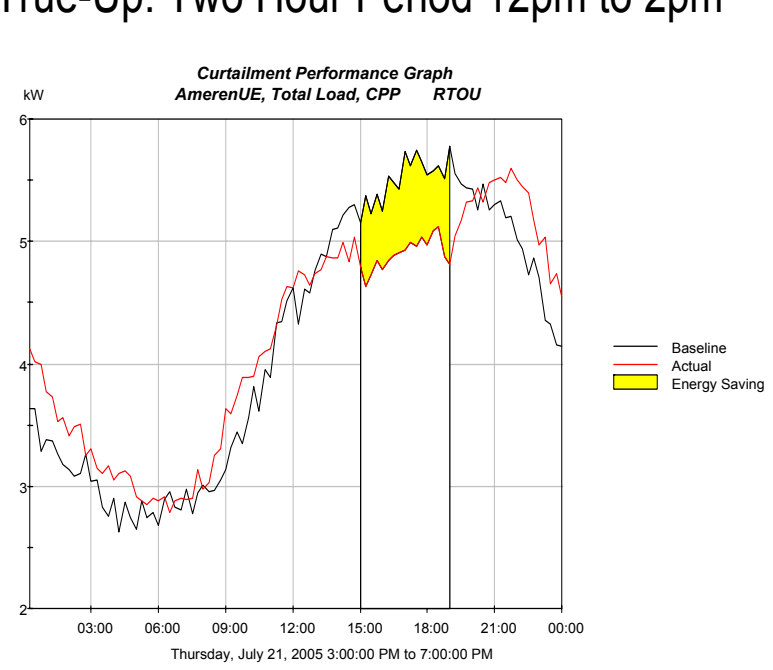
- Four time and temperature settings per day
- Capacity to handle weekday, Saturday and Sunday schedules
- Remote control via wireless communications

Strategic Consulting

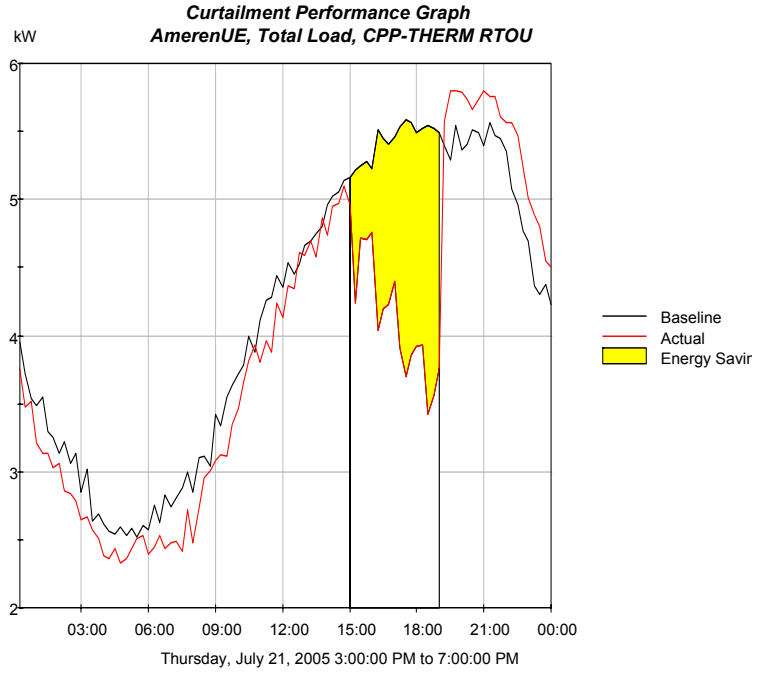
Results -Typical Impact On CPP Event Day

CPP Event Day
July 21, 2005

True-Up: Two Hour Period 12pm to 2pm



CPP Event Day
July 21, 2005



The "CPP Only" group reduced demand by 0.63 kW per participant.
The "CPP W/Smart Thermostat" group reduced demand by 1.36 kW.

2003-2006 in Chicago

1,500 participants representing a wide range of demographics

Utility Role

- ComEd remains the supplier and bills the participant
- Interval meters, read by traditional meter readers
- Consumers pay hourly, market based prices (pass through of PJM hourly price)

Cooperative Role

- The Community Energy Cooperative provides an intermediary role providing outreach, consumer education, high price notifications, etc.

ESPP: Helping Consumers Manage Prices

Information about hourly energy prices

- Education about general price shapes by season,
- Access to each day's prices via a website or phone call-in number.

Notification of high price days of over 13 cents/kWh

- By telephone or email, issued the previous evening

Access to web-based tools

- Charts and graphs of energy use, price and cost down to the hourly level

Online and printed summaries of energy use, costs and comparable flat rate bills

Educational materials on energy efficiency and how to reduce usage during peak times

Elasticities have ranged from .042 to .08.

- Impacted by weather and price each year
- Central Air Conditioner cycling increased elasticity by as much as 50%
- We found elasticities on all summer days, not just high priced ones – this goes beyond just cutting peak and implies load shapes improving
- Success in notifying participants of next day's price improves their response

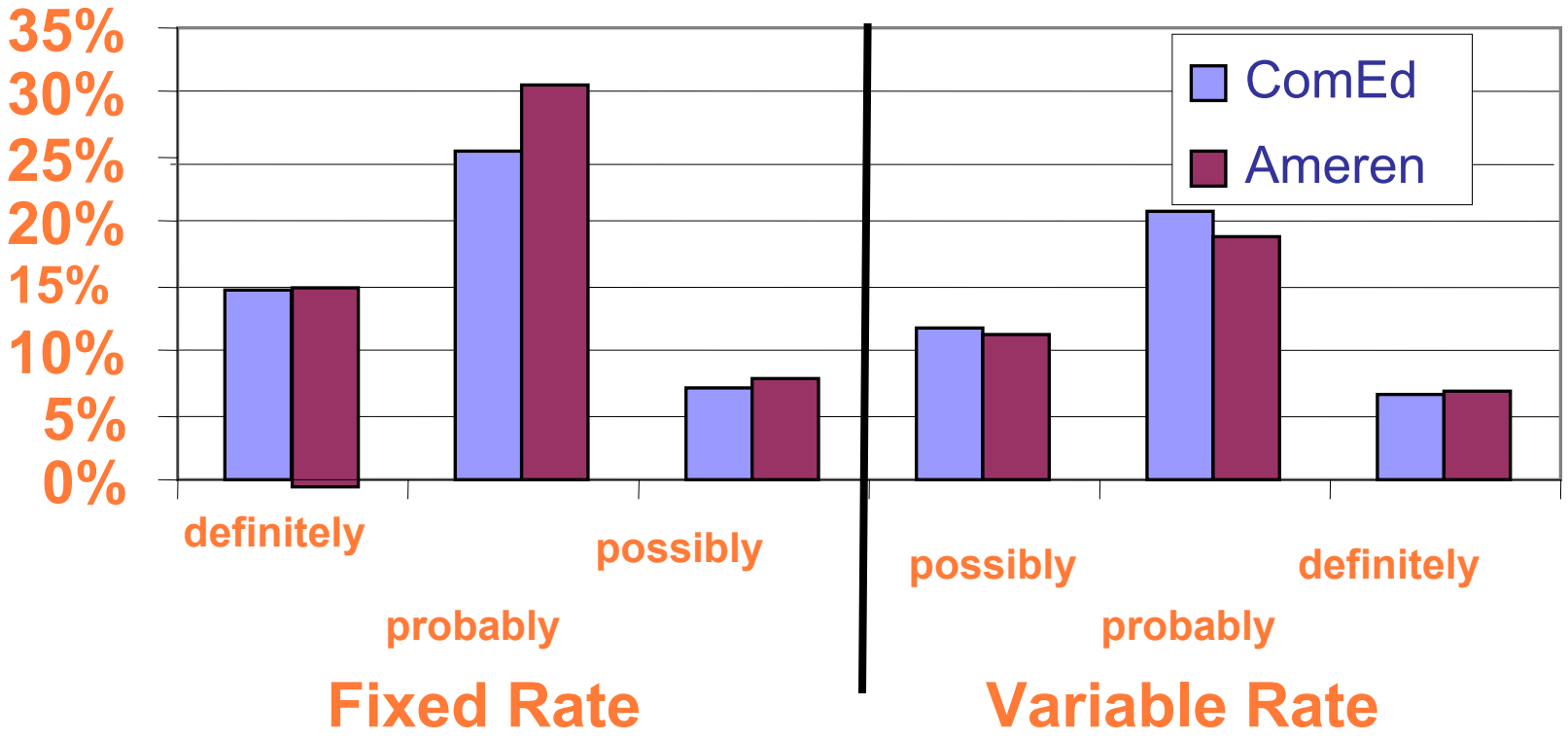
ESPP participants' overall monthly summer energy (kWh) usage suggests a conservation effect

- Reduction in usage of 3% to 4%, relative to what their usage was estimated to be had they not received hourly electricity prices.

Participants report buying ENERGY STAR rated appliances at a high rate and feel more "energy aware"

ESPP: Gauging Customer Interest in Real-time Pricing

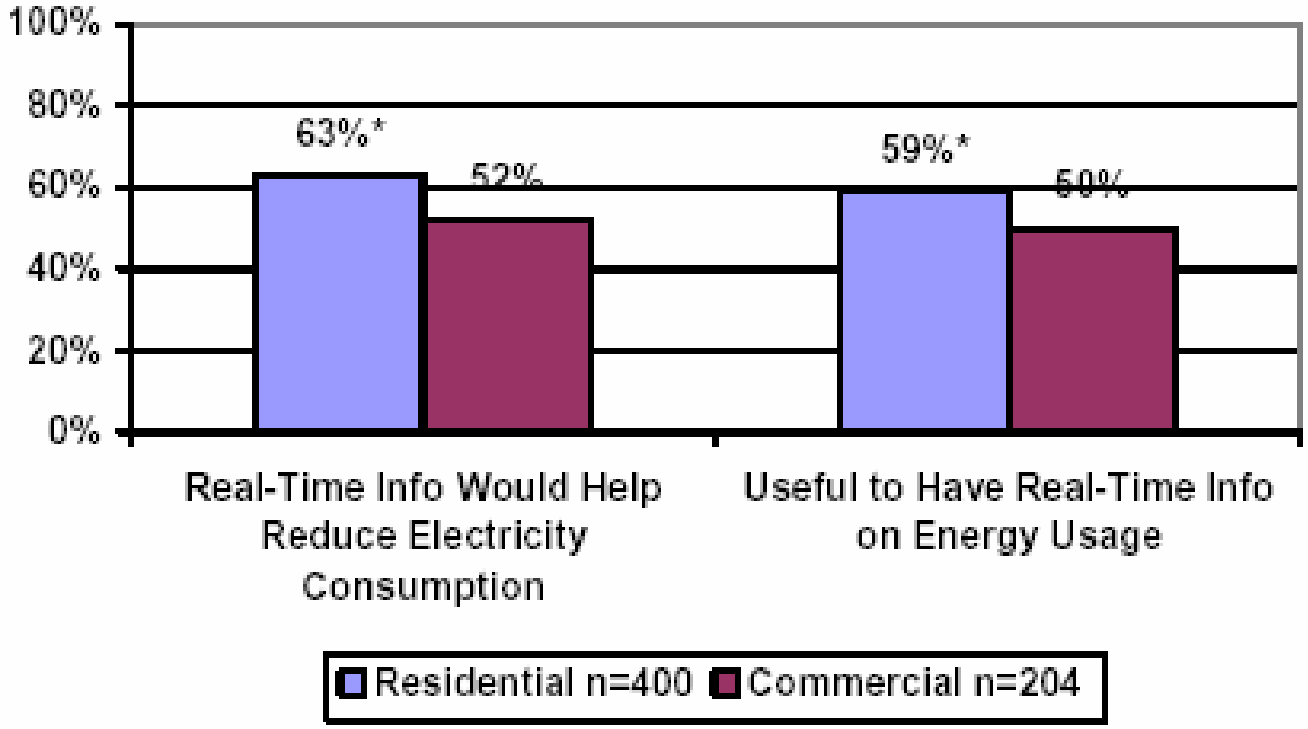
Would You Be Interested In A Fixed Or Variable Rate Plan?



[Summer 2006 Survey. 282 ComEd, 399 Ameren households]

SPP: Interest in Real-Time Energy Displays

Specifically (to lower consumption) and generally



**Significantly higher percentage of residential customers than commercial customers thought that it would be useful to have real-time information and that it would help reduce electricity consumption.*

Source: Nexus Energy Software, Final Report: Information Display Pilot, California Statewide Pricing Pilot, January 5, 2005.

SPP: Consumer Willingness to Pay

Monthly customized energy usage report

Amount	Residential	Commercial
$25 or less	83%	74%
More than $25	9%	16%
Don't know	8%	11%

Real-time display device

Amount	Residential	Commercial
$25 or less	57%	33%
More than $25	42%	66%
Don't know	1%	2%

Source: Nexus Energy Software, Final Report: Information Display Pilot, California Statewide Pricing Pilot, January 5, 2005.

Context: Feedback a Key to Lower Consumption

Results of literature survey

- 38 pilot programs
- Direct (in-home display) and indirect (usage reports)

TABLE 2 CONSERVATION EFFECTS SHOWN IN FEEDBACK STUDIES[8]

Savings	Direct Feedback Studies (n=21)	Indirect Feedback Studies (n=13)	Studies 1987-2000 (n=21)	Studies 1975-2000 (n=38)
20%	3		3	3
20% of peak weekdays only			1	1
15-19% Mondays through Saturdays	1	1	1	3
10-14%	7	6	5	13
5-9%	8		6	9
0-4%	2	3	4	6
Unknown		3	1	3

Source: King and Delurey, "Energy Efficiency and Demand Response: Twins, Siblings, or Cousins?" *Public Utilities Fortnightly*, March 2005.

APU: Spare the Power Days

Customer-friendly rebate approach to critical peak pricing

- Uses “carrot” of rebate instead of “stick” of high critical peak price
- Similar concepts to California’s Statewide Pricing Pilot
  - 10-15 days per year, 11 am-6 pm dispatch hours
- Leave customer on current rate
- Pay customer 35 cents per kWh for peak demand reductions on critical peak days
  - kWh reduced = “baseline” kWh – actual
    - Baseline calculated on non-event days
  - Rebate = 35 cents x number of kWh reduced during critical peak hour

Response

- Rebate works as well as a high critical peak price
- 13% average reduction

Unique, joint-sponsored effort

- Utility (Pepco)
- Public Service Commission
- Office of People's Counsel
- Consumer's Utility Board
- International Brotherhood of Electrical Workers

Two-year pilot to measure:

- Response to dynamic pricing
- Conservation effect of pricing and feedback
- Customer understanding
- Customer satisfaction

SmartPowerDC Overview

Pricing

- Hourly pricing option
- Critical peak pricing
- Critical peak rebate

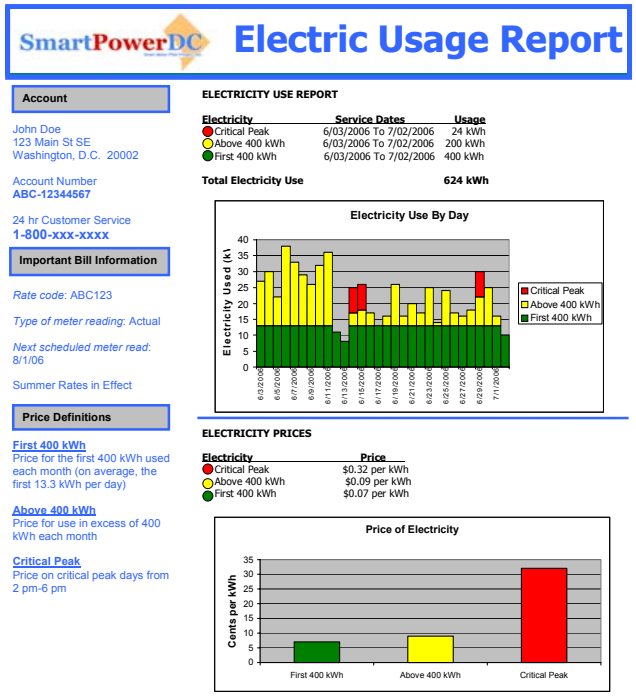
Feedback

- Monthly energy use summary in bill
- Monthly bill to date
- Yesterday's energy cost
- Current electricity price

Technologies*

- Advanced meters
- Smart thermostats
- email
- Automated phone calls

*** - photos generic representations only**



Lessons Learned - Consumers

The Consumer Response Literature

- Typically reduce peak loads 10-20% on time-based pricing
- Typically cut total usage 5-10% when given more feedback on energy use
- Automated control increases both demand response and conservation
- Automated control and time-based pricing are synergistic

Puget Sound Energy

- Set appropriate expectations for customers
- Work closely with the stakeholders

California Statewide Pricing Pilot

- Findings of the literature validated on numerous fronts (customers like information and pricing options and respond to them)
- Feedback via more detailed information on monthly bills is as important as real-time

Spare the Power Days

- Peak Time Rebate offers appealing political alternative while yielding the same level of peak reduction

Current Status

Pricing rollouts planned to follow advanced meter deployment

- California - PG&E: “Pure” CPP to be marketed to all 4.5 million residential customers
- Ontario: all 4.5 million residential customers to be placed on TOU rates
- Connecticut – CL&P: all large residential customers to be placed on TOU rates
- SDG&E Proposal: all 1.3 million residential customers to be placed on CPR

Other major programs

- Illinois – ComEd & Ameren: hourly pricing to be marketed to all 4.5 million residential customers
- Arizona – APS & SRP: TOU pricing is marketed to all 1.5 million residential customers

Conclusion

Thanks for listening!

Questions?

- 650-631-7230
- chris@emeter.com